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ARTICLE

Initial Economic Impacts of the U.S. Pacific Coast Groundfish Fishery Individual Fishing Quota Program

Jerry Leonard* and Erin Steiner
National Marine Fisheries Service, Northwest Fisheries Science Center, Fishery Resource Analysis and Monitoring Division, 2725 Montlake Boulevard East, Seattle, Washington 98112, USA

Abstract

In 2011, management of the limited-entry groundfish trawl fishery on the Pacific coast switched from a system of vessel entry restrictions, gear restrictions, seasonal closures, and bimonthly catch limits to an individual fishing quota (IFQ) program. In addition to advancing a profitable and efficient groundfish fishery, the Pacific Fishery Management Council's objectives for the IFQ program included minimizing the adverse effects on fishing communities and promoting measurable economic and employment benefits. We developed counterfactual revenues and costs for the fleet and used an input–output model to estimate the change in income and employment for the West Coast as a whole and for 12 different port areas. Our results indicated that alternative assumptions regarding the distribution of quota payments substantially changed conclusions about the economic impacts of the IFQ program. Under an assumption that payments to lease quota were distributed to homeports of vessels reporting revenue from the lease or sale of quota, income in most port areas and across the West Coast increased. Alternatively, assuming that there were no quota payments, about half the port areas and the West Coast overall experienced an increase in income. Lastly, assuming that payments to lease quota were a leakage, income decreased in most port areas and across the West Coast. Regardless of the assumption on the distribution of lease payments, the employment in most port areas and throughout the West Coast has declined due to a direct reduction in the number of employee positions on participating vessels. Although increased income resulted in a boost to employment in some areas, it was usually not enough to completely offset the reduction in the number of vessel employees.

The Pacific Coast groundfish fishery consists of more than 90 different species that are managed by the Pacific Fishery Management Council (PFMC) and the National Oceanic and Atmospheric Administration (NOAA) Fisheries through the Pacific Coast Groundfish Fishery Management Plan. The commercial fishery has open-access, limited-entry trawl gear and limited-entry fixed-gear (longlines and pots) components. The fishery is relatively large, with annual groundfish revenue averaging US$102.2 million and revenue from fish landed via trawl gear averaging $68.7 million from 2010 to 2013 (PacFIN 2013).

Due to the co-occurring nature of species in the fishery, it has historically been difficult to harvest some species with ample stocks without overfishing other species. Overfished species affected the harvest of virtually all species with healthy stocks, and management to prevent the "constraining" species from becoming overfished required the fleet to forgo "substantial potential harvests" (PFMC and NMFS 2012). Because some species were overfished and others were at risk of becoming overfished, the PFMC took a series of steps to limit fishing capacity. Limited-entry permits with gear endorsements for trawl and fixed gear were issued by the PFMC in 1993 (PFMC and NMFS 2014). In 2003, the PFMC instituted a trawl endorsed limited-entry permit buyback program to reduce the number of permits, and in 2007 rebuilding plans for overfished species were implemented, which led to the development of a vessel monitoring system to ensure that prohibited fishing did not occur in certain closed areas (PFMC and NMFS 2012).

*Corresponding author: jerry.leonard@noaa.gov
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Prior to 2011, the PFMC managed the trawl segment of the fishery with bimonthly cumulative trip limits in which each vessel could land fish up to the weight limits established for each species, stock, stock complex, or other management unit. The 2-month cumulative limits varied from one period to the next and were adjusted in response to new information regarding bycatch of overfished species. The cumulative limits approach did not provide individual accountability for bycatch of constraining species, which contributed to a view by many participants and observers that the trawl fishery was "economically unsustainable" (PFMC and NMFS 2012).

In 2011, the PFMC converted the limited-entry groundfish trawl fishery to an individual fishing quota (IFQ) program for all vessels that deliver to shoreside processors. The stated goal of the program from the PFMC's final environmental impact statement (EIS) was as follows (PFMC and NMFS 2010a):

> Create and implement a capacity rationalization plan that increases net economic benefits, creates individual economic stability, provides for full utilization of the trawl sector allocation, considers environmental impacts, and achieves individual accountability of catch and bycatch.

This goal was to be supported through a series of six objectives (PFMC and NMFS 2010a). Three of the objectives were to (1) provide a viable, profitable, and efficient groundfish fishery; (2) minimize adverse effects from an IFQ program on fishing communities and other fisheries; and (3) promote measurable economic and employment benefits through seafood catching and processing. Note that these objectives are potentially contradictory because improving profit and efficiency may lead to a decrease in community income, fewer employees, and reductions in employment benefits. Income in a particular community could go down as vessels leave the fishery or because a share of vessel earnings is being paid to quota owners who do not reside in the community.

The IFQ program was expected to increase economic efficiency. The EIS for the program made numerous references to increases in economic efficiency, defined as a condition where "outputs are maximized for a given level of inputs, and production is at its lowest cost" (PFMC and NMFS 2010a). These expectations were heavily based on research by Lian et al. (2010), who estimated that the IFQ program would result in a 50–66% reduction in the number of participating vessels and an annual harvesting cost savings of $18–$22 million (based on 2004 price and cost estimates). The aggregate harvest costs were expected to fall due to (1) increases in scale economies and (2) redistribution of harvest to more efficient vessels.

Prior theoretical and empirical research on IFQ programs has generally focused on the efficiency objective. Theoretical analyses frequently assert improved efficiency gains, reduced overcapacity, and improved resource stocks (Gordon 1954; Scott 1955; Stratton 1969; Libecap 1993; Christy 1996; Grafton et al. 1996). A growing body of empirical literature suggests that IFQ programs generally do promote efficiency, profit, and reduction in capacity (Casey et al. 1995; National Research Council 1999; Newell et al. 2005; Redstone Strategy Group and Environmental Defense 2007; G. S. Gislason and Associates 2008; Gómez-Lobo et al. 2011).

At the time of implementation, the expected effects of the IFQ program on income and employment were less certain than the effects on economic efficiency, especially for individual communities or port areas. These objectives are assessed through an economic impact analysis, where economic impact as defined by Watson et al. (2007) refers to the "net changes in new economic activity associated with an industry, event, or policy." The EIS (PFMC and NMFS 2010a) pointed out several difficulties involved with an economic impact analysis of the IFQ program; for example, the program would likely result in reduced costs "associated with the fixed costs of mooring, insuring, and maintaining vessels" that would be offset by payments to quota owners. Additionally, the EIS indicated that a priori, the impact analysis "cannot predict where the anticipated consolidation of the harvesting sector is likely to occur."

Literature related to the community income and labor impacts resulting from IFQ programs is sparse. The most closely related literature has addressed the economic impact of limiting fishing effort through the establishment of limited entry and the implementation of gear restrictions (Bhat and Bhatta 2006; Steinback et al. 2008). Norman-Lopez and Pascoe (2011) focused on dynamically driven changes in fishery harvest resulting from a transferable quota program in Chile but did not specifically address employment or community economic impacts. Abbott et al. (2010) examined the employment and remuneration effects of IFQs in the Bering Sea/Aleutian Islands crab fisheries, but those authors did not extend the effects to include the total employment and income effects in specific communities, which would entail inclusion of the impacts on household spending and businesses that supply goods and services to fishermen. Carothers (2008) used an ethnographic approach to explore how privatization affected community participation and employment in three Alaskan fishing villages, but again that analysis did not extend to total income and employment effects in the communities.

Here, we utilize cost and earnings data collected through the Economic Data Collection (EDC) program of the NOAA Fisheries' Northwest Fisheries Science Center (Steiner et al. 2015) in conjunction with an input–output (IO) model to estimate how fleet restructuring in the first 2 years of West Coast groundfish IFQ implementation affected income and employment. We focus on impacts stemming from groundfish-related changes in fleet revenue and expenditures. This analysis does not consider any effects resulting from changes in the distribution of processing activity, effects from the injection of money from the federal government for the purposes of managing or monitoring the groundfish fleet, or potential shifts in effort between the groundfish fishery and other fisheries, most

notably those for crab and shrimp. Income and employment impacts are estimated for the West Coast overall and for 12 different port areas that have historically been used to examine the economic impact of groundfish management actions (Leonard and Watson 2011). We focus on the non-whiting component of the limited-entry trawl fleet, which hereafter for simplicity is referred to as the "groundfish fleet." The harvesting of Pacific Hake *Merluccius productus* (also known as Pacific Whiting) is largely distinct from the non-whiting fishery. Vessels that target Pacific Whiting use midwater trawls as opposed to the bottom trawls that are used to harvest most other groundfish species; such vessels also tend to be larger and often target Pacific Whiting exclusively (Lian et al. 2010).

Several features of the West Coast groundfish IFQ program are particularly important to the development of impact estimates. First, there are two distinct privileges that are associated with the program (PFMC and NMFS 2010a): quota share (QS) and quota pounds (QPs). The QS privilege entitles the holder to a specified share of the total allowable catch (TAC) for an indefinite period of time. Each year, QS owners are issued QPs based on their respective shares of the trawl allocation of the TAC for each quota species. The QPs are valid for a specified period of time (typically 1 year) and have been transferable since the start of the IFQ program in 2011. The QSs were not initially transferable, but transfers were allowed starting in 2014 (USOFR 2014a). In 2011 and 2012, QPs could be transferred through sale (cash, barter, or some combination) or lease, whereas QSs could only be leased. Second, QSs or QPs can be held by entities (individuals or businesses) that are not currently using them on fishing vessels that they own. Hence, there is no "owner onboard" requirement as there is for vessels operating in the limited-entry, fixed-gear fishery for Sablefish *Anoplopoma fimbria* (USOFR 2014b). Lastly, prior to IFQ implementation, nearly all of the available trawl allocation had to be landed with trawl gear, but a handful of vessels with exempted fishing permits were permitted to harvest with fixed gear (longlines and pots). The IFQ program removed this requirement altogether such that QPs can be used to make landings with either trawl or fixed gear provided the vessel has a limited-entry permit with a trawl endorsement. Because landings via fixed gear typically obtain higher prices than landings via trawl gear, particularly for Sablefish, removing the trawl gear requirement gave vessels that historically used trawl gear an opportunity to increase revenue through gear switching. It also allowed vessels that traditionally used fixed gear to land fish allocated to the trawl sector upon obtaining the requisite QPs. Together, these features allowed restructuring, consolidation, and redistribution of landings across ports, with corresponding changes in economic impacts.

METHODS

Data

The analysis utilized two main sources of data. To calculate total ex-vessel value by port, state fish tickets were obtained from the Pacific Fisheries Information Network (PacFIN); PacFIN contains revenue information for fish landings and lists the type of gear that was used to harvest the fish. The EDC program collects the cost data that are required to distribute vessel earnings to various factors of production. The EDC program involves mandatory collection of annual cost–earnings data from all vessels that participated in the limited-entry trawl fishery for the 2 years prior to IFQ implementation (i.e., 2009 and 2010) and from all vessels participating in the IFQ program since 2011. Participants in the fishery must certify, under penalty of perjury, that they have reviewed all information in the EDC forms and that it is true and complete to the best of their knowledge (USOFR 2014c). The EDC program collects cost data directly from vessel owners and operators for their West Coast operations. Not all vessel costs incurred are attributable to the IFQ program. Many vessels also engage in other activities that are outside the scope of the IFQ program, such as state crab and shrimp fishing. To analyze the effects of rationalization, costs were allocated to the quota fishery based on the respective share of total vessel landings measured in dollar value (hereafter, "landings").

Counterfactual Scenario

To estimate the economic impacts of IFQ implementation, it was necessary to construct a counterfactual scenario representing conditions that would have existed if implementation had not occurred. For the counterfactual scenario, estimates of the outlays to factors of production (crew payments, fuel, maintenance, etc.) were made by making three basic assumptions for 2011 and 2012: (1) every vessel that was active prior to implementation would have remained active after implementation, and those vessels' respective Leontief production functions (hereafter, "production functions") would have remained constant; (2) the spatial distribution of groundfish landings would not have changed; and (3) there would have been no gear switching. Our basic premise in using these simplifying assumptions was that other factors affecting the fishery would have occurred regardless of the IFQ program. As such, our assumption was that the IFQ program did not affect estimates of optimum yield and did not affect the inter-sector allocation of different species. These assumptions largely fit with expectations for the program (PFMC and NMFS 2010b). Additionally, we assumed that apart from the price changes resulting from the ability to switch to fixed gear, implementation of the IFQ program had no effect on groundfish prices. Although the program could ultimately result in an increase in prices, there was little evidence of this for the primary species that were targeted in the trawl fishery through 2012 (see Appendix Figure A.1).

The production functions for each vessel in the counterfactual scenario were built by examining the factor outlays as a share of total groundfish ex-vessel revenue in 2009 and 2010. Total costs for each factor of production over 2009 and 2010 were divided by ex-vessel revenue from groundfish landings made over that period. The result was an average production function for 2009 and 2010. The counterfactual scenario was established by fixing the factor outlays to the average 2009 and 2010 percentages for each vessel.

When aggregated together, the production function data for participating vessels revealed the changes that occurred after IFQ implementation. The factor outlays as a percentage of landings for all vessels combined are displayed in Table 1. Trawl vessels that remained in the fishery had lower costs for several notable cost categories. Vessel and on-board equipment, insurance, fishing gear repair and maintenance, fuel and lubrication, and captain wages were all lower as a percentage of groundfish revenue (hereafter, "revenue"). When compared to vessels operating with trawl gear, vessels landing trawl-quota groundfish with fixed gear had a lower share of revenues paid to the captain, insurance, and fuel. The notably smaller share paid for fuel indicates the less-fuel-intensive nature of

TABLE 1. West Coast factor outlays by cost category as a percentage of landings value.

Cost category	Non-whiting trawl, average 2009–2010	Fixed gear with trawl endorsement, 2011	Non-whiting trawl, 2011	Fixed gear with trawl endorsement, 2012	Non-whiting trawl, 2012
Bait on the West Coast	0.0	5.0	0.0	4.9	0.0
Captain wages on the West Coast	16.2	9.5	15.5	10.6	15.7
Communication on the West Coast	0.5	0.4	0.4	0.4	0.3
Crew wages on the West Coast	20.8	21.2	21.1	21.1	21.2
Fishing association dues on the West Coast	0.7	0.5	0.9	0.2	1.1
Gear repair and maintenance shared between the West Coast and other	0.3	0.4	0.0	0.4	0.0
Gear repair and maintenance used only on the West Coast	4.0	3.4	3.0	6.0	5.1
Food on the West Coast	1.2	1.4	0.7	0.9	0.8
Freight on the West Coast	0.0	0.1	0.1	0.1	0.0
Fuel and lubrication on the West Coast	13.5	6.1	12.2	10.3	13.3
Ice on the West Coast	1.4	0.4	0.9	0.4	1.2
Insurance premium payments	5.3	2.8	3.8	3.8	4.2
Lease of quota pounds	0.0	31.5	8.6	25.9	5.1
Lease of quota shares	0.0	0.3	0.2	0.4	0.1
Lease of trawl limited-entry permit	0.3	1.5	0.7	0.6	0.6
Lease of vessel	0.4	0.2	0.4	0.1	0.4
License fees on the West Coast	0.0	0.5	0.7	0.5	0.5
Moorage	0.9	0.6	0.6	0.9	0.7
Observers on the West Coast	0.1	0.5	0.6	1.7	1.3
Offloading on the West Coast	0.4	0.8	0.4	0.2	0.7
Processing equipment shared between the West Coast and Alaska	0.0	0.0	0.1	0.1	0.0
Supplies on the West Coast	1.8	0.4	0.9	0.7	1.0
Travel on the West Coast	0.2	0.0	0.1	0.0	0.1
Trucking of fish on the West Coast	0.0	0.1	0.0	0.2	0.0
Vessel and on-board equipment (repaired and improvements)	6.8	9.2	4.1	11.6	5.8
Residual (proprietary income)	25.2	3.1	23.8	(2.1)	20.7
Total (all cost categories)	100.0	100.0	100.0	100.0	100.0

harvesting fish via fixed gear rather than trawl gear. The fixed-gear vessels paid a considerable share of revenue to lease QPs. Fixed-gear vessel lease costs for QPs represented 31.5% of revenue in 2011 and 25.9% in 2012.

In the counterfactual, the distribution of trawl groundfish revenue was based on the average 2009 and 2010 port area distribution of trawl landings. Although landings distribution over time will likely depend on a variety of factors, such as the relevant abundance of various groundfish species, local processor demand, and alternative fishing opportunities that serve as a substitute for groundfish, we expected that over a short time horizon, landings would have remained relatively stable. Under bi-monthly trip limits management prior to the IFQ program, landings were relatively stable during the 4 years preceding 2011 (Table 2). After IFQ implementation, notable increases in the share of groundfish landings occurred in the southern and central Washington area (hereafter, south/central Washington) and the Morro Bay (California) area, and notable decreases in share occurred in Coos Bay (Oregon), Crescent City (California), and Newport (Oregon). Due to confidentiality concerns, the shares for Crescent City in 2011 and 2012 are not revealed in Table 2, but the shares did fall by more than 50%, and the number of vessels delivering to Crescent City declined from 12 in 2009 and 11 in 2010 to fewer than three in 2011 and 2012.

The ability to switch to fixed gear affects the overall revenue generated by groundfish landings because of the higher price received for fish landed via fixed gear, so revenue in the counterfactual scenario assumed that landings made via fixed gear would have been made with trawl gear. Trawl-quota groundfish landed via fixed gear consisted largely of Sablefish. The price per pound of Sablefish landed via fixed gear was 20% and 35% higher than that for Sablefish landed via trawl gear in 2011 and 2012, respectively. For the counterfactual revenue estimates, the lower trawl price per pound was applied to fish landed with fixed gear. Actual revenue and counterfactual revenue are displayed in Table 3 for West Coast ports. As a result of substituting the trawl price for the fish caught with fixed gear in the IFQ, the counterfactual revenue was 4% lower than actual revenue in 2011 and was 4.5% lower than actual revenue in 2012.

Regional Input–Output Model

The employment and income economic impacts were estimated by using a regional IO model, and this section details the construction of the model, the study areas of interest, and the treatment of vessel expenditures. Although IO models were originally used for quantifying the economic effects of exogenous final demand shocks, they are appropriate for use in situations of exogenous output changes, such as a change in fishing output, provided that proper adjustments are made (Steinback 2004). Groundfish-related employment and income were derived by using counterfactual and actual expenditures on the different factors of production shown in Table 1, and the economic impact was the difference between the counterfactual and actual.

Economic impacts derived using an IO model are often expressed as the sum of the direct, indirect, and induced effects (Miller and Blair 1985). In our context, direct effects are the income and employment changes of people who are directly involved in vessel operations. Direct income effects are changes in the wages and salaries of captain and crew and changes in payments to vessel proprietors. Direct employment effects represent the change in the number of captain and crew member positions on vessels as a result of program implementation. The indirect effects encompass the changes in income and employment in sectors that supply goods and services to fishing vessels. Induced effects comprise the changes in income and employment resulting from changes in household spending as the result of a change in income earned among fishing vessels and supporting sectors. Taken together, the indirect and induced effects are the “multiplier” or “ripple”

TABLE 2. Percentage distribution of non-whiting groundfish trawl landings revenue, 2007–2012 (asterisks indicate that there were fewer than three vessels with landings; data not shown due to confidentiality concerns).

Port area	2007	2008	2009–2010 average	2011	2012
Puget Sound, Washington	3.75	3.10	3.58	2.59	3.38
Southern and central Washington	3.03	2.84	3.92	11.91	10.93
Astoria/Tillamook, Oregon	26.62	27.78	25.54	26.73	33.07
Newport, Oregon	13.36	15.52	16.64	12.46	10.30
Coos Bay, Oregon	14.46	14.37	13.91	9.75	10.08
Brookings, Oregon	5.40	5.80	5.75	4.83	5.28
Crescent City, California	3.48	3.02	2.92	***	***
Eureka, California	13.94	12.25	11.50	10.06	9.50
Fort Bragg, California	7.21	7.00	8.23	7.69	6.62
Bodega Bay/San Francisco, California	6.76	5.26	3.20	2.63	1.68
Monterey, California	1.76	1.58	1.75	2.40	2.04
Morro Bay, California	0.23	1.48	3.06	7.81	6.41

TABLE 3. Actual and counterfactual groundfish landings in 2011 dollars and 2012 dollars (asterisks indicate that there were fewer than three vessels with landings; data not shown due to confidentiality concerns).

Port area	Actual 2011	Counterfactual 2011	Actual 2012	Counterfactual 2012
Puget Sound	984,709	1,134,430	854,889	1,006,272
Southern and central Washington	3,178,656	922,046	2,838,673	817,881
Astoria/Tillamook	8,383,223	7,885,530	9,218,212	6,994,690
Newport	3,694,382	4,327,230	2,769,232	3,838,376
Coos Bay	3,177,715	4,452,709	2,948,320	3,949,680
Brookings	1,469,930	1,852,607	1,627,207	1,643,316
Crescent City	***	***	***	***
Eureka	3,354,637	3,747,055	2,778,104	3,323,745
Fort Bragg	2,570,254	2,701,386	1,915,973	2,396,206
Bodega Bay/San Francisco	996,527	961,826	671,595	853,167
Monterey	813,500	572,974	591,992	508,245
Morro Bay	2,615,568	818,177	1,770,876	725,747
West Coast total	31,239,101	29,375,970	27,985,073	26,057,325

effects on the broader economy that result from the direct change to fishing vessels.

Analysis by parts.—The IO modeling was completed by using an "analysis by parts" (ABP) approach with IMPLAN version 3 (IMPLAN Group 2012), which was used previously in a fishing context by Steinback et al. (2008). The ABP approach differs from the standard use of IO analysis in a manner that is particularly useful in this case: where the costs for factors of production are collected through a primary survey. In typical IO analyses, a shock to aggregate demand is placed on one or more target industry sectors or commodities that are included in the model. Total economic impacts or contributions are then estimated as the backward linked effect of a demand change on the target industry or commodity. To calculate an estimate, the direct effect of the demand change is multiplied with the respective industry multipliers. However, ABP does not start with an impact on a target industry or commodity; rather, the impact of a given level of production by the target industry is estimated by first specifying the commodities needed by the target industry to satisfy the given production level. The purchase of these goods and services by the target industry constitutes the first round of indirect purchases by the target industry. The second part of the estimate is to analyze the impact of the payroll needed by the target industry to satisfy the given production level (Manshel 2012).

Using ABP in our context, the indirect effects are generated by commodity (goods and services) purchases of fishing vessels, and the induced effects are generated by payments to the captain, crew, proprietors of vessels operating in the fishery, and fishing quota owners who receive payments for use of quota. The sum of the indirect and induced effects does not include what happens to vessels directly. The direct effects must be added to these indirect and induced effects to obtain the total effects of a given level of harvest.

To facilitate the calculation of income and employment estimates over multiple study areas, we developed a procedure to permit estimates outside of the IMPLAN interface. If one were to use the IMPLAN interface, 870 expenditure changes would have to be entered for the 29 cost categories in Table 4 and for the 12 different study areas. To correctly perform ABP outside of the IMPLAN interface, an IMPLAN model must be manipulated to produce both income and employment "commodity multipliers" for every commodity in the fishing vessel production function (Table 1). IMPLAN produces "industry multipliers" for both income and employment that can be exported directly from the software. However, it does not produce commodity multipliers. When estimating an impact in IMPLAN on a commodity basis, the software apportions an exogenous shock on a target commodity to the industries that produce the commodity. The apportionment to different industries is done by way of a market share of commodity production. If S_{ij} equals the share of industry i in the production of commodity j and if M_i equals the income multiplier for industry i, then the commodity (j) multiplier for income C_j is derived as

$$C_j = \sum_i S_{ij} M_i. \quad (1)$$

The same is done for employment multipliers, with the only difference being that M_i equals the employment multiplier for industry i.

Study areas.—Each of the 12 port-level geographic areas (Figure 1) had a region-specific model constructed in IMPLAN. The study areas were nearly identical to those used by the PFMC in estimating the economic impacts of

TABLE 4. Bridge between primary expense categories and associated IMPLAN Pro sectors.

Cost category	IMPLAN sector	Port receiving payments
Bait on the West Coast	Fishing industry	Landings
Captain wages on the West Coast	Employee compensation	Homeport
Communication on the West Coast	Telecommunications	Homeport
Crew wages on the West Coast	Employee compensation	Homeport
Fishing association dues on the West Coast	Civic, social, professional, and similar organizations	Homeport
Fishing gear repair and maintenance shared between the West Coast and other	Shipbuilding and repairing	Homeport
Fishing gear repair and maintenance used only on the West Coast	Shipbuilding and repairing	Homeport
Food on the West Coast	Personal consumption expenditures vector: food purchased for off-premise consumption	Landings
Freight on the West Coast	Truck transportation	Landings
Fuel and lubrication on the West Coast	Refined petroleum products (margined[a])	Landings
Ice on the West Coast	Soft drink and ice manufacturing	Landings
Insurance premium payments	81.4% insurance carriers; 18.6% insurance agencies, brokerages	Homeport
Lease of quota pounds	Proprietary income	Scenario dependent
Lease of quota shares	Proprietary income	Scenario dependent
Lease of trawl limited-entry permit	Proprietary income	Homeport
Lease of vessel	Proprietary income	Homeport
License fees on the West Coast	State and local government/noneducation	Homeport
Moorage	Other amusement and recreation industries	Landings
Observers on the West Coast	Environmental and other technical consulting services	Landings
Offloading on the West Coast	Shipbuilding and repairing	Landings
Processing equipment shared between the West Coast and Alaska	Shipbuilding and repairing	Homeport
Purchase of trawl limited-entry permit	Proprietary income	Homeport
Supplies on the West Coast	Steinback and Thunberg (2006): distribution of other expenditures	Landings
Travel on the West Coast	Air transportation	Homeport
Trucking of fish on the West Coast	Truck transportation	Landings
Vessel and on-board equipment (repaired and improvements)	Shipbuilding and repairing	Homeport
Residual (proprietary income)	Proprietary income	Homeport

[a]Margined indicates that the prices paid by consumers are the full retail price, which must be converted to the producer prices, with a portion going to the retailer, wholesaler, transportation, and manufacturer.

changes in federal fishing regulations (PFMC and NMFS 2012). However, several of the port areas that are customarily used in groundfish management, such as port areas south of Morro Bay, have very little to no non-whiting trawl groundfish landings. Port areas with no such landings before and after IFQ implementation were not examined. Additionally, fewer than three vessels landed trawl groundfish at both Tillamook (Oregon) and Bodega Bay (California) both before and after IFQ implementation; thus, due to confidentiality concerns, we grouped the Tillamook area with Astoria (Oregon), and we grouped the Bodega Bay area with San Francisco.

Input–output model treatment of fishing expenditures.—The expenditures of fishing vessels (Table 1) must be mapped into relevant IMPLAN commodity categories (Table 4). There are a few categories that require some additional explanation. Expenditures on fuel are "margined." In IO models, expenditures are expressed in terms of producer prices, which represent the value of goods at the point of production rather than at the retail level. Consequently, for goods that are

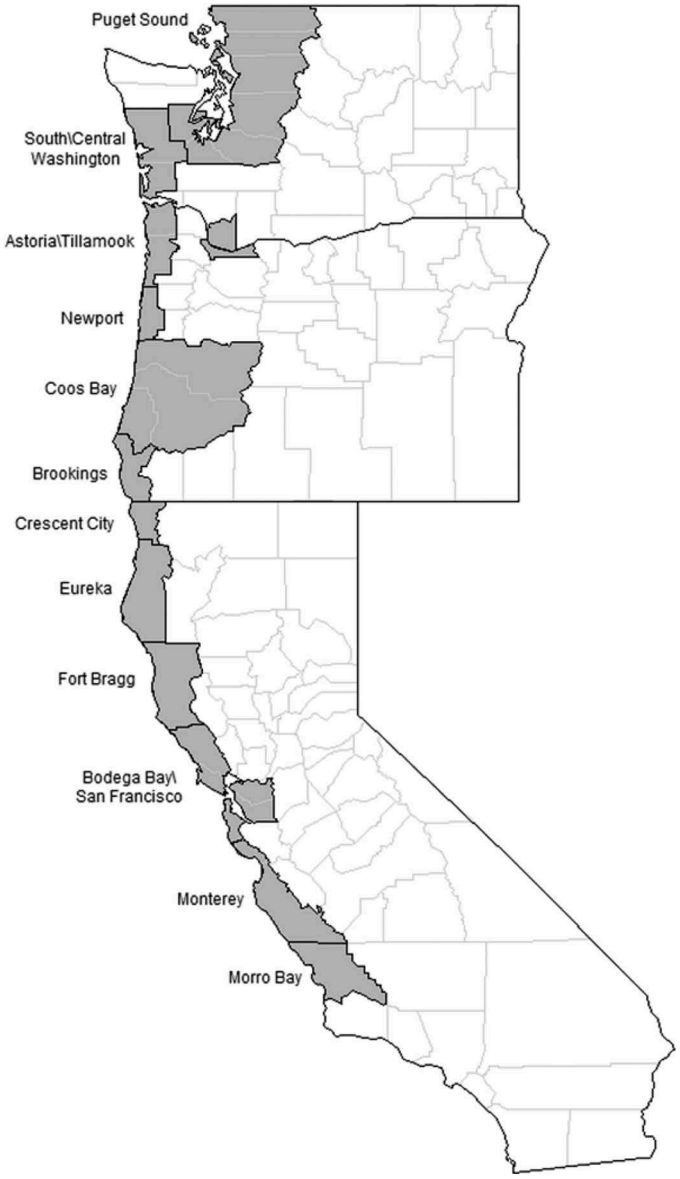

FIGURE 1. Map of the West Coast, showing port study areas in Washington, Oregon, and California, with counties included.

not produced at the time of service (e.g., diesel), the prices paid by final consumers must be allocated, with a portion going to the retailer, wholesaler, transportation, and manufacturer (Olson and Lindall 1999). Food expenditures are distributed following the personal consumption expenditures (PCEs) for off-premise food consumption; the PCE data are derived from the National Income and Product Accounts and are available for use in IMPLAN. The category "supplies on the West Coast" consists of items such as cleaning products, safety items, and clothing. Due to the variety of products included, the supplies category is distributed following Steinback and Thunberg's (2006) category for "other" expenditures. Lastly, payments made for purchasing and leasing QPs or QSs are treated as proprietary income; these are made to owners of fishing quota. Hence, expenditures by one set of proprietors are received as income by another set of proprietors.

While the production functions (Table 1) determine the expenditures on different factors of production for given production levels, some of the commodities acquired will be sourced from producers outside of the study areas. The regional purchase coefficients (RPCs) determine the share of expenditures that are sourced from within the study areas. IMPLAN provides RPC estimates based on estimated trade flows of goods and services between different counties. With the exception of three expenditure categories, we used the RPCs provided by IMPLAN. For bait, moorage, and repair and maintenance, all expenditures were assumed to be sourced 100% from within the relevant study area. The IMPLAN RPCs for these commodities were implausibly low because of an imprecise mapping of the good or service provided and because IMPLAN treats all sources of demand for goods and services (i.e., all types of businesses) as identical. For example, in IMPLAN, the West Coast RPC for shipbuilding and repairing was 12.6%. The low RPC results from aggregation of the North American Industry Classification System codes that comprise shipbuilding and ship repairing. It may be accurate that a relatively high share of newly purchased ships is imported, but this is unlikely to be accurate for ship repairing.

Because vessels in this fishery do not always operate within the bounds of a single port area, the precise areas where vessels make expenditures are unknown. In the context of fishery-related economic impacts, prior literature (e.g., Steinback and Thunberg 2006; Steinback et al. 2008; Leonard and Watson 2011) has assumed that expenditures for operating fishing vessels accrue to the ports where fish landings are made. For example, if 30% of landings by a particular vessel were made in Astoria/Tillamook, then 30% of vessel costs (fuel, crew payments, moorage, etc.) were assumed to be made in Astoria/Tillamook. For the present work, we used an approach in which payments for some cost categories were assumed to accrue to landing ports, while others were assumed to accrue to vessel homeports. It seems unlikely that payments for some factors of production (e.g., insurance payments) will accrue to ports where landings are made. The treatment of each cost category is noted in Table 4; to be complete, results for alternative location assumptions are presented in the Appendix (Figures A.2, A.3).

There was uncertainty about whether quota payments were made for Pacific Whiting or non-whiting species and about the residences of proprietors of quota who received payments; because of this uncertainty, quota costs were allocated by using three alternative assumptions. The uncertainty was due in part to the manner in which the data were collected. Vessels reported both cash quota expenses and quota-related revenue through the EDC survey. However, they did not provide separate transactions by species. Consequently, there was some

ambiguity about whether quota expenses and revenue from the sale or lease of quota were the result of Pacific Whiting-related transactions or non-whiting transactions. From the quota transactions database maintained by the West Coast Region of the National Marine Fisheries Service, it was possible to discern that only a small share of the cash transactions for quota were for Pacific Whiting. For the vessels involved in the non-whiting fishery that are included in this study, 8% of all cash transactions in 2011 and 2012 were for Pacific Whiting. Nevertheless, because of the ambiguity and to highlight the importance of the quota payments on economic impacts, we evaluated three alternative assumptions for the treatment of quota costs, referred to as the DISTRIBUTED, NOPAYMENT, and ABSENTEE scenarios.

Under the DISTRIBUTED scenario, quota costs reported by vessels are made for harvesting non-whiting groundfish, and the quota payments made by vessels are distributed as proprietary income to the homeport of vessels reporting revenue from the lease or sale of quota. The share of quota payments received by a particular area is equal to the sum of quota revenue for vessels in the homeport divided by the sum of total quota revenue reported in all areas. The rationale behind this assumption is that homeports reporting revenue from quota sales and leases are inhabited by proprietors that receive quota payments as income. In this scenario, all payments are assumed to remain on the West Coast and are treated as proprietary income for the West Coast altogether. Under the NOPAYMENT scenario, no quota payments are made. Effectively, this assumption increases the proprietary income of vessels operating in the fishery since they do not have overhead in the form of quota payments. This scenario increases proprietary income payments in areas that serve as homeports for vessels that have increased revenue after the implementation of IFQs. An alternative interpretation of this assumption is that active vessels are only paying proprietors of quota who reside in their respective homeports. Under the ABSENTEE scenario, quota payments are treated as a leakage from all areas. The payments for quota are made but do not flow to the other port areas examined. Instead, the quota payments are made to proprietors who are absent from any of the study areas. For consistency, the payments for quota are also treated as a leakage from the West Coast altogether.

Among the three evaluated assumptions, the one that most accurately depicts reality is uncertain given current information, but we make the following observations. Vessels are reporting sizeable quota expenses and quota revenue. The DISTRIBUTED scenario utilizes the data collected to a greater degree than the other two scenarios, and for this reason it might be considered the most plausible. However, the extent to which the assumption holds that quota payments are distributed proportionally to the homeports of vessels reporting quota revenue is unknown. Additionally, the DISTRIBUTED scenario represents the middle of the two extremes depicted by the other scenarios. The NOPAYMENT scenario is likely to overestimate proprietary income in the form of net revenue because vessels are reporting quota expenses, and we are ignoring those payments. If this scenario is accurate, then port areas with vessels that remain active in the fishery would be the biggest beneficiaries in terms of income and employment. Similarly, for the ABSENTEE scenario, vessels are reporting sizeable revenues generated through the sale or lease of quota, so it would only be completely accurate if none of the vessel owners receiving revenue resides in the homeports of the vessels that they own. For example, this scenario would be accurate if all of the revenue is received by vessel owners residing in Las Vegas or any other location outside of the study areas. When taken together, the results from the three different assumptions illustrate the importance of the spatial accrual of quota payments in estimating the economic impacts, thus emphasizing the need to collect accurate information on their distribution.

RESULTS

Two years after implementation, we observed fleet restructuring through a reduction in active trawl-only vessels and an increase in the vessels using fixed gear. In 2010, prior to implementation, there were 98 vessels harvesting groundfish with trawl gear only, 6 vessels using fixed gear, and 3 vessels using both trawl gear and fixed gear. After implementation in 2011 and 2012, the number of vessels harvesting groundfish with trawl gear only, fixed gear, and both trawl gear and fixed gear was 70, 22, and 4, respectively.

Because of the myriad factors that affected income results by port area, summarizing the key attributes affecting the results is difficult, but we offer some insight by each quota treatment scenario. Regardless of the treatment of quota, the factors affecting income in each port area included the difference between actual and counterfactual landings, the earnings of vessels homeported therein, and actual versus counterfactual cost structure of (1) vessels making landings in the area and (2) vessels homeported therein. Considering the treatment of quota in the DISTRIBUTED scenario, the results were primarily driven by two factors: the change in homeport vessel earnings and whether the homeport vessels were collectively net buyers or sellers of quota. In a port that is neutral with respect to buying or selling quota, if vessel earnings are higher in the actual than in the counterfactual, income within the port likely increases because many factor costs flow back to the homeport, particularly wages and maintenance. Alternatively, if vessel earnings in the actual and counterfactual are identical, but vessels based in the area are net sellers of quota, incomes also likely increase. However, because not all expenditures flow back to the homeport, results were not solely dependent on these two factors. An area that experiences very high landings in the actual compared to the counterfactual could also experience an increase in income regardless of where the delivering vessels are based. In the NOPAYMENT scenario, the “net buyers/sellers of quota” factor

did not affect results. Port areas with relatively high actual compared to counterfactual earnings are likely to have increased incomes as a result of the program. In the ABSENTEE scenario, both factors affected the results. However, because all quota payments are treated as a leakage, the "net buyers/sellers of quota" factor will be negative unless there is a homeport with vessels that collectively make no quota purchases. This occurred for the south/central Washington area in 2011, which is why the results under all three scenarios were identical for that area.

Income and employment in port areas are linked, so the same factors that affected income under each scenario also affected employment; however, for employment, the number of vessels that remain active in the fishery is an additional consideration. As discussed above, the direct employment effect is the number of captain and crew members working directly on the fishing vessels. Hence, a positive direct employment effect for a given port area indicates that the number of captain and crew for vessels homeported therein is higher in the actual than in the counterfactual. Income in the same port area also has an effect on employment. Regardless of the treatment of quota payments, study areas that experience an increase in income also receive a boost in employment due to a higher level of household spending in the area. Although the number of employees directly involved in the fishing industry may decline in a particular area due to reduction in the number of homeported vessels, the higher level of income in some cases offsets this decline. This occurred in the DISTRIBUTED scenario for south/central Washington and Monterey (California). The loss of direct fishing industry jobs was offset by jobs created among services and industries that comprise a relatively high share of household spending, such as food services, health practitioners, hospitals, and retail trade businesses.

The 2011 and 2012 results are given as the difference between actual and counterfactual, and they are grouped based on the scenarios for distribution of quota payments. Figure 2 presents the income results and Figure 3 presents the employment results under the three different scenarios for quota payments. The estimates graphed in Figures 2 and 3 are also presented in the Appendix Tables A.1–A.3.

Under the DISTRIBUTED scenario, just over half of the port areas experienced an increase in income during 2011 and 2012 (Figure 2a and 2d). In 2011, the largest increase in income was observed in Astoria/Tillamook, followed by Morro Bay and Puget Sound. In Puget Sound, actual landings were lower than counterfactual landings. However, vessels using Puget Sound as a homeport had increased landings in other ports, and proprietary income in the form of net revenue was distributed to the homeport in this scenario. In 2011, Coos Bay, Newport, and Crescent City exhibited the largest downturn in income. The reduction in income was primarily due to actual landings being lower than counterfactual landings (Table 3). The results for 2012 were similar to those for 2011, with one notable exception. Morro Bay was among those areas with the sharpest increases in income during 2011, yet it faced a reduction in income during 2012. While actual landings were greater than counterfactual landings for Morro Bay in 2012, the vessels responsible for the increase in landings did not have a Morro Bay homeport; rather, they were vessels from Astoria/Tillamook. In 2009 and 2010, before IFQ implementation, 100% of landings in Morro Bay were made by vessels from Morro Bay. This number fell to 47% in 2011 and to only 27% in 2012. The high income effects in Astoria/Tillamook were partially the result of increased fish deliveries in Morro Bay because payments to proprietors and crew were distributed to the Astoria/Tillamook homeport. For the West Coast altogether, income increased by $3.4 million in 2011 and by $2.2 million in 2012, with the majority coming from the direct effect of more income paid to captain, crew, or proprietors. The positive indirect/induced effect reveals that the higher direct effect on income more than offsets the lower payments on factors of production, such as fuel and maintenance.

In the DISTRIBUTED scenario, half of the port areas had increased employment during 2011, and less than half of the areas experienced an increase during 2012 (Figure 3a and 3d). For the West Coast overall, employment was down in both 2011 and 2012. The direct effect in each port area was the estimated change in the number of employee positions on vessels based in each homeport. The indirect/induced effect closely corresponds to the change in income, so if a port area has a positive income change, it will also likely have a positive change in employment. By a wide margin, Astoria/Tillamook received the greatest increase in employment—the result of both a positive direct effect and a positive indirect/induced effect because it was also the area with the greatest income change. Other areas with increases in employment during 2011 included Puget Sound, Morro Bay, south/central Washington, Monterey, and Fort Bragg (California). The remaining areas experienced a decrease in employment. For several areas and across the West Coast, the indirect/induced effect was positive but not large enough to offset the negative direct effect. For the West Coast, the overall effect was a loss of 21 employees in 2011 and a loss of 19 employees in 2012.

The results for the NOPAYMENT scenario were similar to those observed under the DISTRIBUTED scenario for most port areas and for the West Coast (Figure 2b and 2e). The majority of port areas experienced an increase in income. Additionally, for both 2011 and 2012, all port areas that had an increase in income under the DISTRIBUTED scenario also had an increase under the NOPAYMENT scenario. This was also the case for employment (Figure 3). The West Coast results were nearly identical to those obtained from the DISTRIBUTED scenario. The slight difference was due to some quota payments being made to vessels with homeports in Alaska. These payments were treated as a leakage from the West Coast in the DISTRIBUTED scenario.

The income differences between the first two scenarios reveal some information about the relative effect of changes

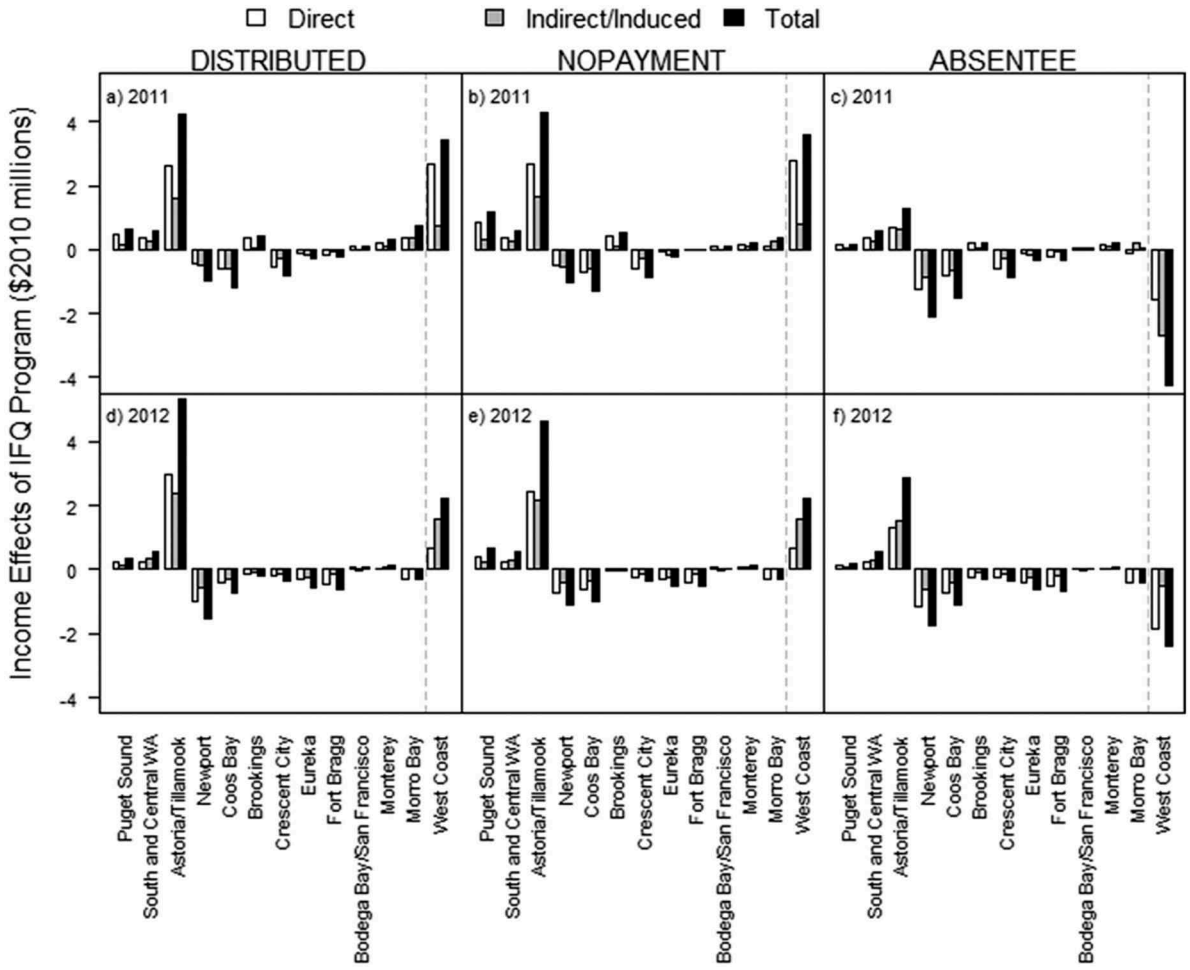

FIGURE 2. Income impacts (millions of U.S. dollars [2010 dollars]) of the individual fishing quota (IFQ) program in 2011 and 2012 based on three different assumptions about who receives quota payments (DISTRIBUTED, NOPAYMENT, and ABSENTEE scenarios; see Methods).

in earnings of active vessels versus changes in payments received from the lease or sale of quota by homeport. For example, Puget Sound increased the most in the NOPAYMENT scenario compared to the DISTRIBUTED scenario. The relatively large difference between the two scenarios was attributable to increased landings of Puget Sound-based vessels in ports other than Puget Sound and the fact that those vessels were making quota payments to quota owners who were not based in Puget Sound. The same was true for Astoria/Tillamook, Brookings (Oregon), Eureka (California), and Fort Bragg. The reverse was indicated for Newport, Coos Bay, Crescent City, San Francisco, Monterey, and Morro Bay. For these areas, more income was generated through the lease or sale of quota than through a change in earnings of homeport vessels.

Under the ABSENTEE scenario, the income effects and employment effects in most port areas and across the West Coast declined as a result of implementation (Figures 2c, 2f, 3c and 3f). Unlike the first two scenarios, the positive effect of higher incomes generated by the program due to lower factor payments and higher revenues was absent under this assumption. All port areas that had positive income effects in the first two scenarios still had positive income effects under the ABSENTEE scenario, but the magnitude of the positive effect was reduced; for those areas where income declined, the declines were sharper. The same was also true for employment except at Fort Bragg, which had slight employment gains in the first two scenarios (Figure 3). For the West Coast overall during 2011 and 2012, income fell by $4.2 million and $2.4 million, respectively, and employment fell by 65 and 45 employees, respectively, under this scenario.

DISCUSSION

After only 2 years of implementation, the groundfish rationalization program had already resulted in fleet restructuring. This restructuring increased the efficiency of the fleet, as evidenced by declining factor production costs as a share of

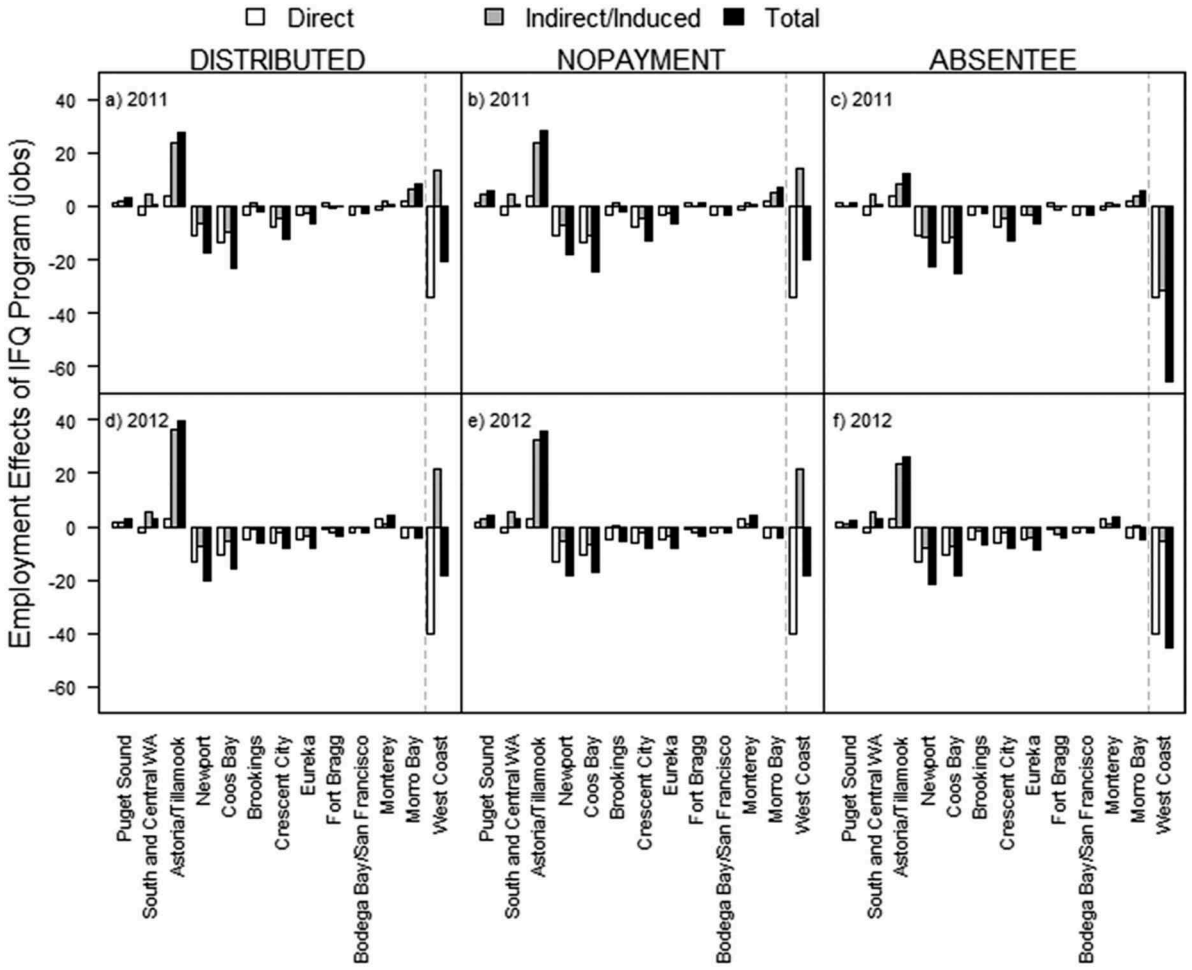

FIGURE 3. Employment impacts (number of jobs) of the individual fishing quota (IFQ) program in 2011 and 2012 based on three different assumptions about who receives quota payments (DISTRIBUTED, NOPAYMENT, and ABSENTEE scenarios; see Methods).

vessel revenues. The decline in factor production costs resulted in higher proprietary income in the form of higher net revenue and payments for the use of quota. Fleet restructuring due to the IFQ program is still ongoing and will continue in the years ahead, but the changes encountered during the first 2 years resulted in sizeable economic impacts. The impacts presented here offer some insight into employment and income effects in subsequent years.

Rather than examine the total income and employment effects on the nation, which one might do to evaluate whether the program meets the goals laid out in the Magnuson–Stevens Fishery Conservation and Management Act, we evaluated income and employment at the community level and found a marked dependency on the assumption made about who receives quota payments. This finding reveals the importance of tracking quota ownership to assess the overall economic impacts of the IFQ program, and it potentially indicates that management measures intended to enhance the association between quota ownership and the geographic areas where quota is utilized could have sizeable effects on the economic impact. The West Coast results indicated that if quota payments had been distributed to proprietors residing in and spending proceeds in the area, income would have increased by $5.6 million in 2011 and 2012 combined. However, if quota payments had been received by proprietors that no longer resided in or spent proceeds on the West Coast (i.e., ABSENTEE scenario), income would have fallen by about $6.6 million, for a difference of more than $12 million relative to the DISTRIBUTED scenario. The substantial difference was similar for employment. Results suggest that payments to quota owners outside of fishing communities have a substantial effect on the respective regional economies.

Beyond the importance of tracking quota ownership, the results raise a number of policy issues that may warrant additional research. One question is whether there are policy tools capable of enhancing the association between quota ownership

and the locations where it is utilized. Perhaps some quota set-aside could be used to support community fishing associations. Giving some quota to a community-designated body to administer as they see fit could potentially anchor some quota to specific locations. The Magnuson–Stevens Fishery Conservation and Management Act authorizes the creation of fishing communities and regional fishery associations for this purpose (Stoll and Holliday 2014). There are many examples of these organizations already in place (Stoll and Holliday 2014). The PFMC held public hearings to scope the idea in the West Coast groundfish fishery when the IFQ program was nearing implementation (NOAA 2010), but community fishing associations were never implemented. Another approach is an "owner on-board" requirement. An owner on-board requirement is already present for vessels operating in the limited-entry, fixed-gear fishery for Sablefish (USOFR 2014b). In this fishery, a person with an ownership interest in the vessel must be on board at any time the vessel is retaining Sablefish. Such a requirement could increase the likelihood that the quota owner lives and spends income in the communities where vessels operate. However, even if quota could be anchored to particular communities, it is possible that such restrictions could have impacts on other IFQ program objectives, such as efficiency and profitability. As was indicated by Kroetz et al. (2015), restrictions to achieve social goals can result in efficiency costs. Regardless of management decisions to balance the different objectives, the magnitude of the differences in our results highlights why tracking quota ownership is—and will likely continue to be—important in assessing the overall economic impacts of the IFQ program.

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Appendix: Ex-Vessel Prices for Groundfish and Results for Alternative Payment Location Assumptions

There is little evidence that groundfish prices for the most valuable species have increased as a result of individual fishing quota (IFQ) program implementation. When pre-2011 trawl landings and the IFQ trawl landings in 2011–2012 were combined, the four species displayed in Figure A.1 comprised 88% of all landings revenue. Figure A.1 indicates that for three of the species, prices were up strongly after 2010. However, prices were also up by roughly the same amount for non-trawl landings that were made outside of the IFQ program. The similarity in price trends provides some evidence that the change in prices after 2010 was driven by factors exogenous to the program.

To examine the effects of allocating costs to the homeport, allocating costs to the port of landings, or the combination approach used in the paper, we produced results based on three alternative assumptions. A blended approach (referred to as the "blend" approach in Figures A.2 and A.3) was used, with some expenses accruing to homeports and others accruing to ports where landings occurred (Table 4). The two alternatives to the blended approach were 100% cost allocation based on landings of groundfish and 100% cost allocation to vessel homeports. Allocation of costs based on the landings ports is the approach that was followed by Steinback and Thunberg (2006), Steinback et al. (2008), and Leonard and Watson (2011). The results of the homeport and blended approaches were very similar for the West Coast and port areas, whereas the landings approach indicated a few notable differences. In particular, the landings approach resulted in less income and employment for Astoria/Tillamook and greater income and employment for the Morro Bay area and the south/central Washington area. Astoria/Tillamook serves as the homeport for a number of vessels that have landings in both Morro Bay and south/central Washington.

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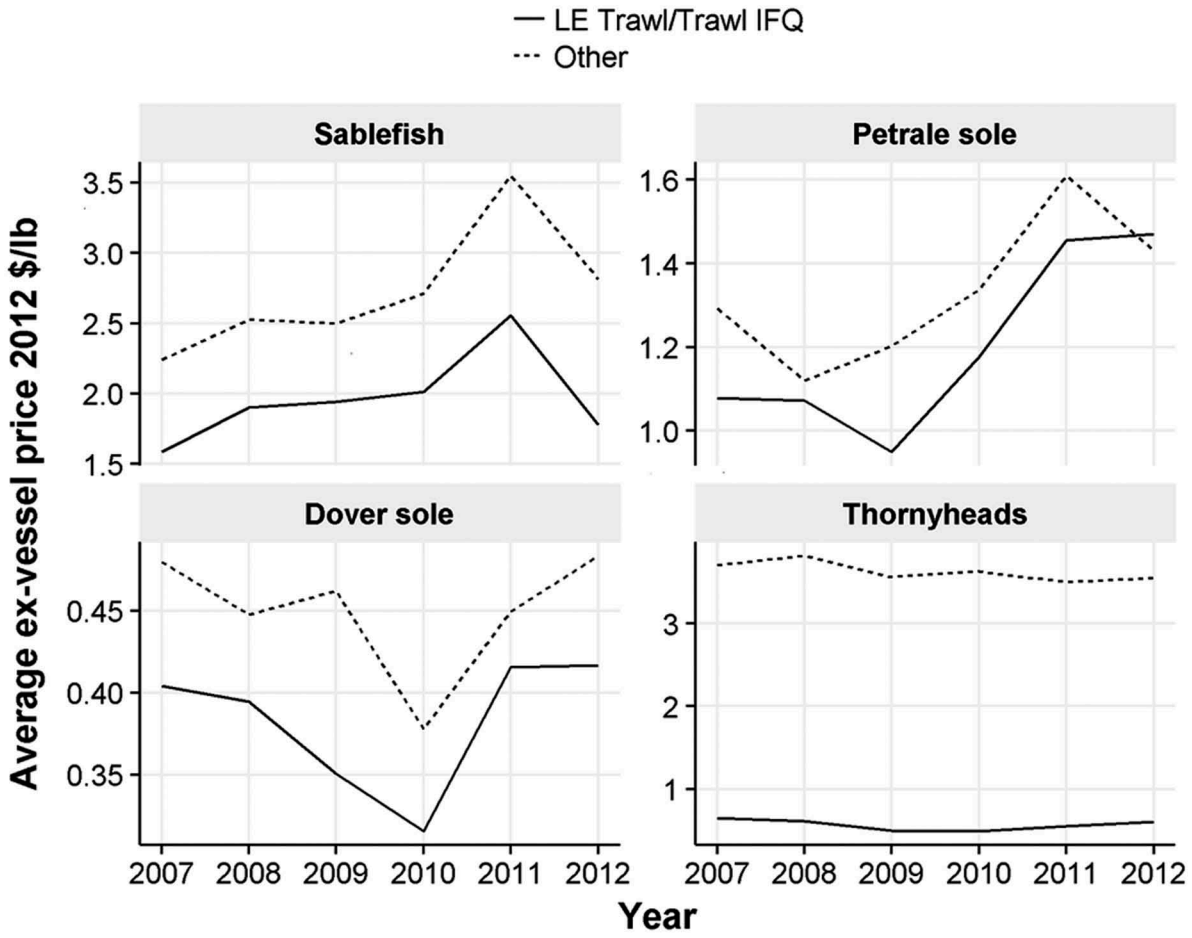

FIGURE A.1. Average ex-vessel prices (U.S. dollars [2012 dollars] per pound) for the four highest valued groundfish species (Sablefish *Anoplopoma fimbria*, Petrale Sole *Eopsetta jordani*, Dover Sole *Microstomus pacificus*, and thornyheads *Sebastolobus* spp.) targeted by the (1) limited-entry (LE) trawl fishery (pre-2011) and trawl individual fishing quota (IFQ) program (2011–2012); and (2) the non-trawl and non-IFQ fishery during 2007–2012.

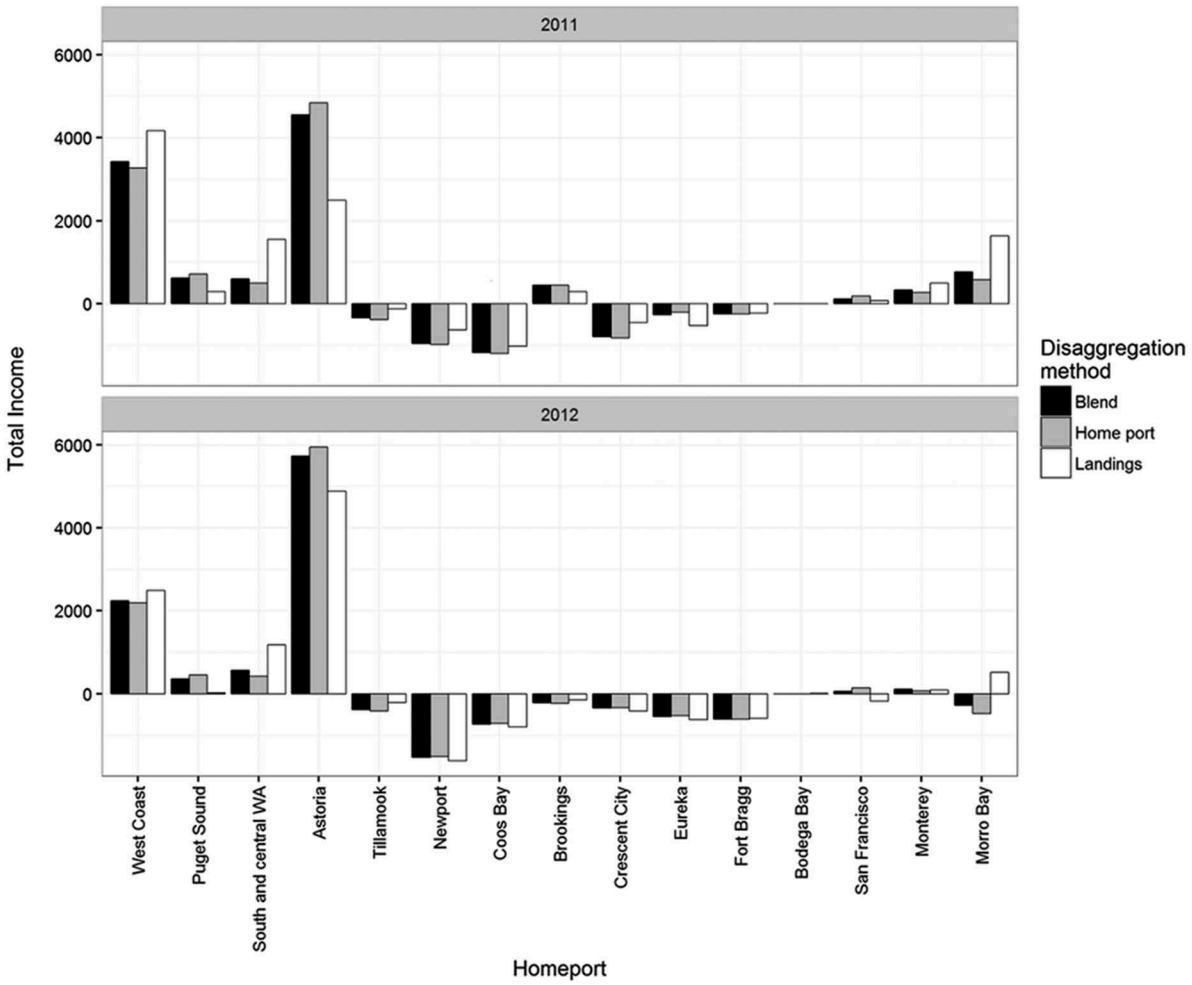

FIGURE A.2. Total income: non-quota costs (U.S. dollars) in each study area for the three disaggregation methods (allocating costs to the homeport, allocating costs to the port of landings, or the combination [blend] approach).

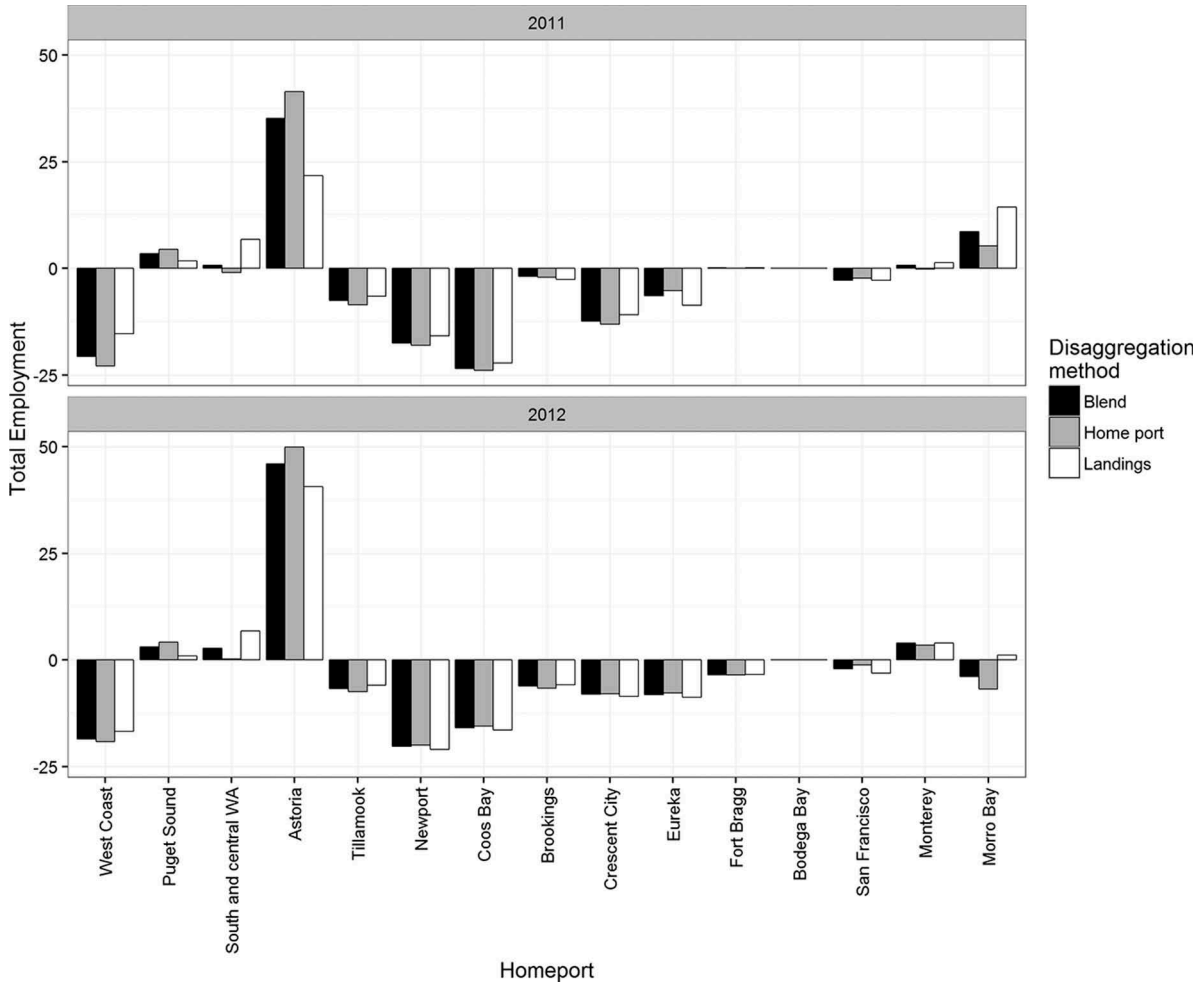

FIGURE A.3. Total employment: non-quota costs (number of jobs) in each study area for the three disaggregation methods (allocating costs to the homeport, allocating costs to the port of landings, or the combination [blend] approach).

TABLE A.1. Income and employment impacts of the DISTRIBUTED scenario, in which quota payments were distributed based on receipts of quota sale or lease. Negative values are shown in parentheses.

Area	2011			2012		
	Direct	Indirect/induced	Total	Direct	Indirect/induced	Total
Income effects (thousands of U.S. dollars [2010 dollars])						
Puget Sound, Washington	486	133	619	237	127	364
Southern and central Washington	352	244	595	244	320	564
Astoria/Tillamook, Oregon	2,599	1,613	4,212	2,948	2,386	5,335
Newport, Oregon	(454)	(501)	(956)	(984)	(547)	(1,531)
Coos Bay, Oregon	(606)	(573)	(1,179)	(428)	(302)	(730)
Brookings, Oregon	383	63	446	(154)	(59)	(213)
Crescent City, California	(520)	(273)	(793)	(215)	(125)	(339)
Eureka, California	(98)	(175)	(273)	(318)	(231)	(549)
Fort Bragg, California	(188)	(60)	(248)	(449)	(158)	(607)
Bodega Bay/San Francisco, California	119	(4)	115	66	(6)	60
Monterey, California	225	110	335	50	59	109
Morro Bay, California	388	378	765	(318)	34	(284)
West Coast	2,685	740	3,425	680	1,561	2,241
Employment effects (number of jobs)						
Puget Sound	1.5	2.0	3.5	1.5	1.6	3.1
Southern and central Washington	(3.5)	4.2	0.7	(2.5)	5.3	2.8
Astoria/Tillamook	4.0	23.6	27.6	3.0	36.3	39.3
Newport	(11.0)	(6.5)	(17.5)	(13.0)	(7.3)	(20.3)
Coos Bay	(13.5)	(10.0)	(23.5)	(10.5)	(5.5)	(16.0)
Brookings	(3.0)	1.1	(1.9)	(5.0)	(1.2)	(6.2)
Crescent City	(8.0)	(4.5)	(12.5)	(6.0)	(2.1)	(8.1)
Eureka	(3.5)	(2.9)	(6.4)	(4.5)	(3.7)	(8.2)
Fort Bragg	1.0	(0.9)	0.1	(1.0)	(2.5)	(3.5)
Bodega Bay/San Francisco	(3.0)	0.2	(2.8)	(2.0)	(0.1)	(2.1)
Monterey	(1.0)	1.7	0.7	3.0	1.0	4.0
Morro Bay	2.0	6.6	8.6	(4.0)	0.0	(4.0)
West Coast	(34.0)	13.3	(20.7)	(40.0)	21.5	(18.6)

TABLE A.2. Income and employment impacts of the NOPAYMENT scenario, in which there were no quota payments. Negative values are shown in parentheses.

Area	2011			2012		
	Direct	Indirect/induced	Total	Direct	Indirect/induced	Total
Income effects (thousands of U.S. dollars [2010 dollars])						
Puget Sound	844	322	1,167	420	224	644
Southern and central Washington	352	244	595	236	318	554
Astoria/Tillamook	2,663	1,636	4,299	2,462	2,153	4,615
Newport	(511)	(526)	(1,037)	(699)	(422)	(1,121)
Coos Bay	(694)	(609)	(1,303)	(606)	(375)	(982)
Brookings	427	74	500	(21)	(25)	(46)
Crescent City	(583)	(293)	(876)	(232)	(130)	(362)
Eureka	(66)	(163)	(229)	(289)	(220)	(509)
Fort Bragg	(9)	1	(8)	(388)	(137)	(525)
Bodega Bay/San Francisco	95	(17)	78	56	(11)	45
Monterey	150	81	232	58	62	119
Morro Bay	104	271	375	(318)	34	(284)
West Coast	2,771	810	3,581	680	1,561	2,241
Employment effects (number of jobs)						
Puget Sound	1.5	4.5	6.0	1.5	2.8	4.3
Southern and central Washington	(3.5)	4.2	0.7	(2.5)	5.2	2.7
Astoria/Tillamook	4.0	24.0	28.0	3.0	32.6	35.6
Newport	(11.0)	(6.9)	(17.9)	(13.0)	(5.5)	(18.5)
Coos Bay	(13.5)	(10.7)	(24.2)	(10.5)	(6.8)	(17.3)
Brookings	(3.0)	1.3	(1.7)	(5.0)	(0.5)	(5.5)
Crescent City	(8.0)	(4.8)	(12.8)	(6.0)	(2.2)	(8.2)
Eureka	(3.5)	(2.7)	(6.2)	(4.5)	(3.5)	(8.0)
Fort Bragg	1.0	0.1	1.1	(1.0)	(2.2)	(3.2)
Bodega Bay/San Francisco	(3.0)	0.0	(3.0)	(2.0)	(0.1)	(2.1)
Monterey	(1.0)	1.3	0.3	3.0	1.0	4.0
Morro Bay	2.0	5.0	7.0	(4.0)	0.0	(4.0)
West Coast	(34.0)	14.2	(19.8)	(40.0)	21.5	(18.6)

TABLE A.3. Income and employment impacts of the ABSENTEE scenario, in which quota payments were treated as leakage. Negative values are shown in parentheses.

	2011			2012		
	Direct	Indirect/induced	Total	Direct	Indirect/induced	Total
Income effects (thousands of U.S. dollars [2010 dollars])						
Puget Sound	167	(35)	131	136	74	210
Southern and central Washington	352	244	595	236	318	554
Astoria/Tillamook	675	625	1,300	1,306	1,546	2,852
Newport	(1,268)	(857)	(2,125)	(1,145)	(617)	(1,762)
Coos Bay	(830)	(665)	(1,494)	(703)	(415)	(1,118)
Brookings	209	18	227	(217)	(75)	(292)
Crescent City	(583)	(293)	(876)	(237)	(132)	(368)
Eureka	(133)	(188)	(321)	(381)	(256)	(637)
Fort Bragg	(231)	(75)	(306)	(508)	(179)	(687)
Bodega Bay/San Francisco	70	(31)	39	35	(24)	12
Monterey	150	81	232	28	50	78
Morro Bay	(121)	187	66	(408)	0	(408)
West Coast	(1,543)	(2,698)	(4,241)	(1,858)	(502)	(2,361)
Employment effects (number of jobs)						
Puget Sound	1.5	(0.3)	1.2	1.5	0.9	2.4
Southern and central Washington	(3.5)	4.2	0.7	(2.5)	5.2	2.7
Astoria/Tillamook	4.0	8.4	12.4	3.0	23.4	26.4
Newport	(11.0)	(11.6)	(22.6)	(13.0)	(8.3)	(21.3)
Coos Bay	(13.5)	(11.7)	(25.2)	(10.5)	(7.6)	(18.1)
Brookings	(3.0)	0.2	(2.8)	(5.0)	(1.5)	(6.5)
Crescent City	(8.0)	(4.8)	(12.8)	(6.0)	(2.2)	(8.2)
Eureka	(3.5)	(3.1)	(6.6)	(4.5)	(4.1)	(8.6)
Fort Bragg	1.0	(1.2)	(0.2)	(1.0)	(2.9)	(3.9)
Bodega Bay/San Francisco	(3.0)	(0.1)	(3.1)	(2.0)	(0.3)	(2.3)
Monterey	(1.0)	1.3	0.3	3.0	0.9	3.9
Morro Bay	2.0	3.7	5.7	(4.0)	(0.5)	(4.5)
West Coast	(34.0)	(31.4)	(65.4)	(40.0)	(5.4)	(45.4)